

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): A system for adding an interference-resistant, inaudible code to an audio signal comprising:

a sampler arranged to sample the audio signal at a sampling rate and to generate therefrom a plurality of overlapping short blocks of sampled audio, each of the short blocks having a duration less than a minimum audibly perceivable signal delay;

a processor arranged to combine the plurality of overlapping short blocks into a long block having a predetermined minimum duration;

a frequency transformation arranged to transform the long block into a frequency domain signal comprising a plurality of independently modulatable frequency indices, wherein a frequency difference between two adjacent ones of the indices is determined by the minimum duration and the sampling rate;

a frequency selector arranged to select a neighborhood of frequency indices so that the frequency difference between a lowest index and a highest index within the neighborhood is less than a predetermined value; and,

an encoder arranged to modulate two or more of the indices in the neighborhood so as to make a selected one of the indices an extremum while keeping the total energy of the neighborhood constant.

Claim 2 (original): The system of claim 1 wherein the processor comprises a digital computer having a buffer memory.

Claim 3 (original): The system of claim 1 wherein the frequency transformation comprises a Fast Fourier Transform algorithm.

Claim 4 (original): The system of claim 1 wherein the encoder comprises an algorithm that increases the energy of a selected index in the neighborhood and that decreases the energy of a short block associated therewith.

Claim 5 (currently amended): A method of adding a code to a frequency band of a sampled audio portion of a composite signal without thereby introducing a perceptible delay between the encoded audio portion and another portion of the composite signal, the method comprising ~~the steps of:~~

a) selecting a sampling rate and a frequency difference between adjacent ones of a predetermined number of frequency indices included in a frequency neighborhood;

b) determining from the sampling rate and from the frequency difference a duration of a long block of samples;

c) determining ~~an integral~~ a number of overlapping sequential ~~sub-blocks~~ short blocks to make up the long block, where the ~~integral~~ number is selected so that each of the ~~sub-blocks~~ short blocks has a ~~sub-block~~ duration less than the perceptible delay; and,

d) processing the long block so as to modulate a selected one of the frequency indices without changing a total signal energy of the band.

Claim 6 (original): The method of claim 5 wherein the composite signal comprises a television broadcast signal and wherein the another portion of the composite signal comprises a video signal.

Claim 7 (currently amended): The method of claim 5 wherein ~~in step d)~~ the processing the long block comprises modulating two or more of the frequency indices within the neighborhood so as to make a selected one of the indices an extremum.

Claim 8 (currently amended): ~~An apparatus~~ Apparatus for reading a code from an audio signal, ~~the code comprising a sequence of blocks having a predetermined number of samples of the audio signal, the code comprising a synchronization block followed by a predetermined number of data blocks, the apparatus comprising:~~

a buffer memory arranged to sequentially hold ~~one of the blocks~~ blocks of samples of the audio signal;

a frequency transformation arranged to transform ~~the one~~ blocks into spectral data spanning a ~~predetermined number of frequency bands, wherein each of the frequency bands comprises a respective neighborhood of frequency indices;~~

a processor arranged to examine a first plurality of predetermined frequency bands in spectral data associated with a first block to determine, for each of the neighborhoods, if [[a respective]] predetermined one of the frequency indices is modulated in the predetermined frequency bands of the first plurality have a predetermined characteristic; and,

a vote determiner arranged to determine that the first one block is ~~the a~~ a synchronization block if ~~[[, in]]~~ the predetermined frequency indices of a majority of the predetermined frequency bands in the first plurality have the predetermined characteristic; ~~the respective modulated frequency index is a respective index selected for inclusion in the synchronization block;~~

wherein the processor is further arranged to examine a second plurality of predetermined frequency bands in spectral data associated with a second block to determine if, in one of the data blocks received subsequent to the synchronization block, a respective

~~predetermined one of the frequency indices is modulated~~ if the frequency indices in the predetermined frequency bands of the second plurality match one of a set of patterns;

wherein the vote determiner is further arranged to ~~determine if, in a majority of the frequency bands, the respective modulated frequency index is a respective index selected for inclusion in the one data block~~ identify a code from the second block if a majority of the second plurality of frequency bands associated with the second block have frequency indices that match a same pattern.

Claim 9 (original): The apparatus of claim 8 wherein the frequency transformation comprises a Fast Fourier Transform algorithm executed by a digital computer.

Claim 10 (original): The apparatus of claim 8 wherein the processor comprises a general purpose digital computer operating under program control and having a plurality of algorithms stored in a memory.

Claim 11 (currently amended): The apparatus of claim 8 wherein the vote determiner comprises ~~an algorithm~~ software executed by a digital computer.

Claim 12 (cancelled)

Claim 13 (currently amended): The method of claim ~~[[12]]~~ 37 wherein a value of k is read as the code ~~bit~~ in step e) if ~~the~~ a k^{th} index in ~~each~~ a majority of the bands ~~is modulated~~ match.

Claim 14 (currently amended): The method of claim [[12]] 37 wherein the ~~predetermined index pattern comprises a~~ patterns comprise pseudo-random sequence sequences.

Claim 15 (currently amended): A system for adding an inaudible code to a tone-like audio portion of a composite signal having two or more portions, the system comprising:

- a sampling apparatus arranged to sample audio at a sampling rate and to generate therefrom a plurality of overlapping short blocks of sampled audio, each of the short blocks having a duration less than a minimum audibly perceptible signal delay;
- a processor arranged to combine the plurality of overlapping short blocks into a long block having a predetermined minimum duration;
- a frequency transformation arranged to transform the long block into a frequency domain signal comprising a plurality of independently modulatable frequency indices located in a plurality of frequency bands;
- an encoder arranged to modulate two or more of the indices in each of the frequency bands so as to make a respective selected one of the indices an extremum while keeping a total acoustic energy of the audio constant;
- a signal analyzer arranged to determine if the tone-like audio portion has a tone-like character within any one of the predetermined number of neighborhoods; and,
- an encoder suspender arranged to suspend the encoding of the encoder within any neighborhood in which the tone-like audio portion has a tone-like character.

Claim 16 (original): The system of claim 15 wherein the audio signal is part of a television broadcast signal.

Claim 17 (original): The system of claim 15 wherein the frequency transformation comprises a Fast Fourier Transform algorithm.

Claim 18 (original): The system of claim 16 wherein the signal analyzer comprises a computer arranged to carry out a masking algorithm described in ISO/IEC 13818-7:1997.

Claim 19 (currently amended): A method for adding an inaudible code to at least one of a predetermined number of frequency neighborhoods within a tone-like audio portion of a composite signal having one or more additional portions, the method comprising ~~the steps of:~~

- a) sampling the audio portion and generating from the sampled signal a plurality of overlapping short blocks, each of the short blocks having a duration less than a minimum audibly perceptible signal delay;
- b) combining the plurality of overlapping short blocks into a long block having a predetermined minimum duration;
- c) transforming the long block into a frequency domain signal comprising a plurality of independently modulatable frequency indices;
- d) identifying those neighborhoods, if any, of the predetermined number of frequency neighborhoods in which the tone-like audio portion has a tone-like character; and,
- e) modulating a respective index in each neighborhood not identified in ~~[[step]]~~ d) so as to make a selected index in such neighborhood an extremum while keeping the total acoustic energy of the audio portion constant, and not modulating an index in any of those neighborhoods identified in ~~[[step]]~~ d).

Claim 20 (original): The method of claim 19 wherein the composite signal comprises a television broadcast signal and wherein one of the additional portions comprises a video signal.

Claim 21 (currently amended): The method of claim 19 wherein ~~step e)~~ transforming the long block comprises ~~the step of transforming the long block according to a Fast Fourier Transform.~~

Claim 22 (currently amended): The method of claim 19 wherein ~~step e)~~ transforming the long block comprises ~~a sub-step of carrying out a masking algorithm described in~~ ISO/IEC 13818-7:1997.

Claim 23 (currently amended): A broadcast audience measurement system in which an inaudible code added to an audio signal is read by a decoding apparatus located within a statistically sampled dwelling, the system comprising:

an encoder arranged to add a predetermined code ~~bit~~ to each frequency band in of a predetermined ~~number~~ plurality of odd frequency bands within a ~~bandwidth of~~ the audio signal;

a receiver within the dwelling arranged to receive the encoded audio portion; and,

a decoder ~~having an input from the receiver,~~ the decoder arranged to acquire a respective test value ~~of the code bit~~ from each of the frequency bands in the predetermined plurality of frequency bands, to compare the acquired test values, to determine that one of the test values is the code ~~bit~~ only if that the one of the test value values is acquired from a majority of the frequency bands in the predetermined plurality of frequency bands, and to otherwise determine that none of the acquired test values is the ~~no code bit has been read~~.

Claim 24 (original): The broadcast audience measurement system of claim 23 wherein the audio signal is part of a television broadcast signal.

Claim 25 (original): The broadcast audience measurement system of claim 23 wherein the receiver includes a microphone.

Claim 26 (original): The broadcast audience measurement system of claim 23 wherein the receiver comprises an audio output jack.

Claim 27 (currently amended): A broadcast audience measurement system in which an inaudible code added to an audio signal is read within a statistically sampled dwelling unit, the system comprising:

an encoding apparatus arranged to add a code bit to a sampled long block of the audio signal, the long block comprising a ~~predetermined~~ number of overlapping short blocks, each of the short blocks having a predetermined duration that is selected to be short enough not to be perceptible to a member of a broadcast audience, the encoding apparatus being further arranged to modulate a selected frequency index in each of a plurality of frequency neighborhoods so as to make each selected index an extremum in the respective neighborhood thereof while keeping a total energy of the audio signal constant;

a receiver within the dwelling, the receiver being arranged to acquire the encoded audio signal; and,

a decoder arranged to read the code from the audio signal, the decoder having an input from the receiver, the decoder comprising a buffer memory arranged to store one of the short blocks, the buffer memory being arranged to store a long block.

Claim 28 (original): The broadcast audience system of claim 27 wherein the audio signal is part of a television signal.

Claim 29 (original): The broadcast audience system of claim 27 wherein the encoder comprises a frequency transformation arranged to transform the long block into a frequency domain signal.

Claim 30 (original): The broadcast audience system of claim 27 wherein the receiver comprises a microphone.

Claim 31 (original): The broadcast audience system of claim 27 wherein the receiver comprises an audio output jack.

Claim 32 (currently amended): A method of encoding an audio signal comprising the following steps:

- a) generating a plurality of overlapping short blocks from the audio signal, wherein each of the short blocks has a duration less than a minimum audibly perceivable signal delay;
- b) combining the plurality of overlapping short blocks into a long block;
- c) transforming the long block into a spectrum comprising a plurality of independently modulatable frequency indices; and,
- d) modulating at least two of the indices so as to make one of the indices an extremum while keeping the total energy of a neighborhood of the modulated indices substantially constant.

Claim 33 (original): A method of reading a code element from an audio signal comprising the following steps:

- a) transforming at least a portion of the audio signal into spectral data spanning a predetermined number of frequency bands having a plurality of frequency neighborhoods;
- b) determining, for each of the neighborhoods, if one of the frequency indices is modulated; and,
- c) assigning a transmitted code value to the code element if, in a majority of the neighborhoods, the respective modulated frequency index is an index selected for inclusion in the audio signal.

Claim 34 (new): An apparatus as defined in claim 8 wherein the first plurality and the second plurality contain the same frequency bands.

Claim 35 (new): An apparatus as defined in claim 8 wherein the code is a binary number.

Claim 36 (new): An apparatus as defined in claim 35 wherein the binary number is represented by a position of an index having a predefined characteristic in a majority of the bands of the second plurality.

Claim 37 (new): A method of reading a code from an audio signal comprising:

- a) examining a first plurality of predetermined frequency bands in spectral data associated with a first block to determine if predetermined frequency indices in the predetermined frequency bands of the first plurality have a predetermined characteristic;

b) determining that the first block is a synchronization block if the predetermined frequency indices of a majority of the predetermined frequency bands in the first plurality have the predetermined characteristic;

c) repeating a)-b) with another block if the predetermined frequency indices of a majority of the predetermined frequency bands in the first plurality have the predetermined characteristic;

d) examining a second plurality of predetermined frequency bands in spectral data associated with a second block to determine if the frequency indices in the predetermined frequency bands of the second plurality match one of a set of patterns;

e) identifying a code from the second block if a majority of the second plurality of frequency bands associated with the second block have frequency indices that match a same pattern.

Claim 38 (new): A method as defined in claim 37 wherein each of the patterns is uniquely associated with a respective code bit.

Claim 39 (new): A method of reading a code from an audio signal comprising:
acquiring a test value from each frequency band in a predetermined plurality of frequency bands associated with the audio signal;
comparing the acquired test values;
determining that one of the test values is a code only if the one of the test values is acquired from a majority of the frequency bands in the predetermined plurality of frequency bands; and

determining that none of the acquired test values is the code if none of the test values is acquired from a majority of the frequency bands in the predetermined plurality of frequency bands.